

Color-Enhance Satellite Images of Coastal Areas

Multispectral satellite images of coastal settings can be used to evaluate the biophysical materials of the shallow water-bottom as well as those of the adjacent onshore area. Because water strongly absorbs near-infrared and longer wavelengths, natural-color combinations of shorter-wavelength, less-strongly absorbed visible light bands from Landsat TM, QuickBird, and similar sensors are the most useful color satellite images for interpreting submerged features. But the partial absorption of visible light in the water column darkens the submerged areas compared to the land surface, and the preferential absorption of red light shifts the hues of submerged features toward blue. As a result, standard manipulations of global contrast and brightness for a coastal scene cannot produce an image that is optimal for both land and water features.

The WATER script in the series of geospatial *Scripts by Jack™* first separates the areas of land and water and then applies specialized contrast and color enhancement to the submerged water features. It produces a color-composite with an enhanced natural color image for the bottom features of the shallow-water area and either a natural color, color-infrared, or grayscale (with choice of near-infrared or green bands) image for the land area.

The WATER script requires a set of multispectral satellite image bands (blue, green, red, and near-infrared) that have been calibrated to scaled surface reflectance values using the SRFI geospatial script (see the *Scripts by Jack* color plates entitled *Satellite Image Calibration Scripts* and *Calibrate Satellite Images to Surface Reflectance*). SRFI-values in the near-infrared and blue bands are used to classify and then separate the water and land cells in the source image and produce a WATERMASK raster object. This mask (which can be filtered using an accompanying FILTER_WATERMASK script) is then automatically used to apply separate color enhancement to the water and land areas. You can run the script using default parameters to enhance land and water features, or you can adjust individual enhancement parameters (with separate settings for land and water areas) to apply overall brightening, selectively brighten dark features, and add or subtract red hues. Step-by-step instructions and the conceptual background for the WATER and FILTER_WATERMASK scripts are provided and illustrated in Part G of *FAQs by Jack™*.



Natural color display of QuickBird multi-spectral image bands (2-meter cell size) of a small coastal area near Key West, Florida. Islands range from urbanized (upper left) to mostly vegetated (center right). Most of the image is clear shallow water less than 2 meters deep with differing proportions of bare sediment and seagrass. The darker channels are 3 to 5 meters deep. Contrast enhancement tailored to the land areas leaves the shallow water areas too dark and too blue.



Sample results from WATER.sml with different options for land areas in the fused image

These illustrations of the Key West test area show sample results from the WATER script using different processing options for the land portion of the image. The water area in all images is an enhanced natural-color band combination that compensates for the varying

absorption of different wavelengths (colors) by water. Left, natural-color band combination for land. Center, color-infrared band combination for land. Right, grayscale display of near-infrared image band for land area.

Dr. Jack F. Paris, a private remote-sensing and geospatial consultant/coach, has developed a collection of advanced, model, geospatial **Scripts by Jack™** and associated documentation called **FAQs by Jack™**. These scripts are in the public domain and can be used and modified as desired. For access to the scripts and FAQs, more information, and contact with Jack, go to: www.microimages.com/freestuf/ScriptsByJack.htm